

WHAT IS CLAIMED IS:

- 1                   1.       A substrate processing system comprising:  
2                   a processing chamber for holding a substrate during processing;  
3                   an alternating voltage supply connected with the processing chamber to  
4 capacitively couple energy to a plasma formed within the processing chamber; and  
5                   an impedance matching network coupled with the alternating voltage supply,  
6 the impedance matching network comprising:  
7                   a variable resistive element having a first plurality of states to define  
8 distinct real parts of an impedance in accordance with the first plurality of states; and  
9                   a variable reactive element having a second plurality of states to define  
10 distinct imaginary parts of the impedance in accordance with the second plurality of states.
- 1                   2.       The substrate processing system recited in claim 1 wherein the  
2 alternating voltage supply includes an intrinsic resistive matching load.
- 1                   3.       The substrate processing system recited in claim 2 wherein the variable  
2 resistive element comprises a transformer for transforming the intrinsic resistive matching  
3 load into one of the distinct real parts of the impedance in accordance with a state of the  
4 transformer.
- 1                   4.       The substrate processing system recited in claim 3 wherein the  
2 transformer comprises:  
3                   a first coil having a fixed number of turns coupled with the intrinsic resistive  
4 matching load; and  
5                   a secondary coil having a variable number of turns corresponding to the first  
6 plurality of states.
- 1                   5.       The substrate processing system recited in claim 4 wherein the first  
2 plurality of states consists of a finite number of discrete states, each such state being defined  
3 by a position of a switch to select a number of turns in the secondary coil.
- 1                   6.       The substrate processing system recited in claim 4 wherein the first  
2 plurality of states is a continuum of states.

1                   7.       The substrate processing system recited in claim 1 wherein the variable  
2 reactive element comprises a coil in series with the variable resistive element, the coil having  
3 a variable number of turns corresponding to the second plurality of states.

1                   8.       The substrate processing system recited in claim 7 wherein the coil  
2 comprises a plurality of inductive elements connected in series with the variable resistive  
3 element, the second plurality of states being defined by a state of a switch to select a subset of  
4 the plurality of inductive elements.

1                   9.       The substrate processing system recited in claim 1 wherein the second  
2 plurality of states consists of a finite number of discrete states.

1                   10.      The substrate processing system recited in claim 1 wherein the second  
2 plurality of states is a continuum of states.

1                   11.      The substrate processing system recited in claim 1 wherein the first  
2 plurality of states consists of a finite number of discrete states.

1                   12.      The substrate processing system recited in claim 1 wherein the first  
2 plurality of states is a continuum of states.

1                   13.      The substrate processing system recited in claim 1 wherein the  
2 alternating voltage supply comprises a radio-frequency voltage supply.

1                   14.      A method for processing a substrate, the method comprising:  
2 positioning the substrate in a processing chamber;  
3 capacitively coupling an alternating voltage supply with the processing  
4 chamber to couple energy to a plasma formed within the processing chamber; and  
5 matching an impedance defined by processing conditions for the substrate,  
6 comprising:

7                               matching a real part of the impedance by selecting one of a first  
8 plurality of states of a variable resistance element coupled with the alternating voltage  
9 supply; and

10                            matching an imaginary part of the impedance by selecting one of a  
11 second plurality of states of a variable reactive element coupled with the alternating voltage  
12 supply.

1                   15.     The method recited in claim 14 wherein:  
2                   the alternating voltage supply includes an intrinsic resistive matching load;  
3     and  
4                   matching the real part of the impedance comprises transforming the intrinsic  
5     resistive matching load with a transformer in accordance with a state of the transformer.

1                   16.     The method recited in claim 15 wherein:  
2                   the transformer comprises a first coil having a fixed number of turns coupled  
3     with the resistive matching load and a second coil having a variable number of turns  
4     corresponding to the first plurality of states; and  
5                   matching the real part of the impedance comprises selecting the number of  
6     turns for the second coil.

1                   17.     The method recited in claim 16 wherein:  
2                   the first plurality of states consists of a finite number of discrete states, each  
3     such state being defined by a position of a switch to select a number of turns in the secondary  
4     coil; and  
5                   matching the real part of the impedance comprises positioning the switch.

1                   18.     The method recited in claim 16 wherein the first plurality of states is a  
2     continuum of states.

1                   19.     The method recited in claim 14 wherein:  
2                   the variable reactive element comprises a coil in series with the variable  
3     resistive element, the coil having a variable number of turns corresponding to the second  
4     plurality of states; and  
5                   matching the imaginary part of the impedance comprises selecting the number  
6     of turns for the coil.

1                   20.     The method recited in claim 19 wherein:  
2                   the coil comprises a plurality of inductive elements connected in series with  
3     the variable resistive element; and  
4                   selecting the number of coils comprises selecting a state of a switch to select a  
5     subset of the plurality of inductive elements.

1                    21.     The method recited in claim 14 wherein the alternating voltage supply  
2   comprises a radio-frequency voltage supply.